Obtaining Geometrical Properties of Binary Images from two Projections Using Neural Networks

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In Binary Tomography Reconstruction the task is to obtain the two-dimensional cross-section images of three-dimensional objects from a small number of projections. While numerous methods exist for solving this problem, all of them presume certain prior knowledge about the binary image to be reconstructed. Such assumed features are often of geometrical type, like connectedness or convexity. The aim of our work is to extract these geometrical properties from the projections themselves, so that they can ease the task of choosing the proper reconstruction method, or setting its parameters appropriately.

For retrieving this additional information from the projections we used the Artificial Neural Network model, which consists of an interconnected group of artificial neurons. We managed to train neural networks to recognize several different features (hv-convexity, 4-connectedness, etc.) with the use of large datasets containing horizontal- and vertical projection values and the desired output for each input pattern. For each classification task we set the optimal parameters of the network by running small tests in advance, and performing a thorough testing with the configurations proved to be the most promising.

Our experiments [1] verified that certain geometrical information of binary images can be acquired from merely the projections. With the use of neural networks we successfully separated hv-convex discrete sets from random binary images; 8-, but not 4-connected discrete sets from hv-convex polyominoes; and we got good results in the classification of hv-convex binary images and almost hv-convex polyominoes for higher resolutions.

References

[1] Gara, M., Tasi, T. S. and Balázs, P. Learning connectedness and convexity of binary images from their projections. *Pure Mathematics and Applications*, 20(1–2):27–48, 2009.